## CLAIMS

What is claimed is:

1. A metal oxide material comprising at least one metallic oxide wherein said metallic oxide is aligned in a three-dimensionally periodic orientation so as to confer a symmetric nanostructural morphology to said metal oxide material.

2. The metal oxide material of claim 1, wherein the symmetric nanostructural morphology has a pre-determined symmetry.

3. The metal oxide material of claim 1, wherein the metallic oxide is selected from the group consisting of ZnO, $In_2O_3$, and combinations thereof.

4. The metal oxide material of claim 1, wherein the symmetric nanostructural morphology is selected from the group consisting of a nanobridge, nanonail, nanoribbon, nanowire, nanowall nanobrush and combinations thereof.

5. The metal oxide material of claim 1, wherein the metallic oxide further comprises a dopant material.

6. The metal oxide material of claim 5, wherein the dopant materials is tin.

7. The metal oxide material of claim 1, comprising a first metallic oxide and a second metallic oxide, wherein said first metallic oxide forms a central nanostructural spine having a linear axis, whereupon said second metallic oxide forms terminally attached three-dimensional periodically oriented linear nanostructural rods, the linear axes of said nanostructural rods being oriented substantially non-parallel to the linear axis of said nanostructural spine of said first metallic oxide.

8. The metal oxide material of claim 1, comprising at least three metallic oxides

9. The metal oxide material of claim 8, wherein the metallic oxides are selected from the group consisting of ZnO, $GeO_2$ and $In_2O_3$.

10. The metal oxide material of claim 1, with a pre-determined symmetry consisting essentially of 2-fold symmetry, 4-fold symmetry or 6-fold symmetry or combinations thereof.

11. The metal oxide material of claim 7, wherein the central nanostructural spine consists essentially of $In_2O_3$.

12. The metal oxide material of claim 7, wherein second metallic oxide consists essentially of ZnO, $GeO_2$ or MgO.

13. The metal oxide material of claim 7, wherein the central nanostructural spine has a length ranging between 0.01 and 100 μm.

14. The metal oxide material of claim 7, wherein the central nanostructural spine has a length ranging between 1 and 20 μm.

15. The metal oxide material of claim 7, wherein the central nanostructural spine has a thickness ranging between 10 and 1000 nm.

16. The metal oxide material of claim 7, wherein the central nanostructural spine has a thickness ranging between 50 and 500 nm.

17. The metal oxide material of claim 7, wherein the nanostructural rods comprising the second metallic oxide have a length ranging between. 0.01 and 100 μm..

18. The metallic oxide material of claim 7, wherein the nanostructural rods comprising the second metallic oxide have a length ranging between 2 and 5 μm.

19. The metal oxide material of claim 7, wherein the nanostructural rods comprising the second metallic oxide have a width ranging between 10 and 1000 nm.

20. The metal oxide material of claim 7, wherein the nanostructural rods comprising the second metallic oxide have a width ranging between 20 and 200 nm.

21. The metal oxide material of claim 7, wherein the nanostructural rods comprising the second metallic oxide are substantially orthogonal to the linear axis of said central nanostructural spine.

22. The metal oxide material of claim 7, wherein the nanostructural rods comprising the second metallic oxide are slanted to the central nanostructural spine so as to form a finite, non-orthogonal angle with the linear axis of said central nanostructural spine.

23. The metal oxide material of claim 7, wherein at least one of the metallic oxides further comprises a dopant material.

24. The metal oxide material of claim 23, wherein the dopant material is tin.

25. A process for the formation of a metal oxide material with symmetric nanostructural morphology comprising the steps of :

a) crystallizing a first metallic oxide so as to form a thermally stable structure having three-dimensionally periodic orientations; and

b) infiltrating the structure formed by the first metallic oxide with a second metallic oxide to form a composite material so as to confer a symmetric nanostructural morphology to said composite material.

26. The process of claim 25, wherein the metal oxide material with symmetric nanostructural morphology is formed by the steps comprising:

a) forming a metallic oxide source mixture of a pre-determined ratio comprising at least two metallic oxides;

b) placing said metallic oxide source mixture in a reactor cell comprising a closed end and an open end, said open end further comprising a collector; and

c) subjecting said reactor cell comprising the metallic oxide source mixture contained therein to an elevated temperature under reduced pressure so as to enable formation

of crystalline metal oxide material having three-dimensional periodic nanostructural morphology.

27. The process of claim 26 wherein the metallic oxide source mixture comprises a single metallic oxide.

28. The process of claim 26, wherein the reactor cell comprises a thermally stable material selected from the group consisting of metal, metal alloy and ceramic.

29. The process of claim 26, wherein the collector is a thermally stable material selected from the group consisting of a graphite, a metal, silicon, $LaAlO_3$ and $SrTiO_3$.

30. The process of claim 26, wherein the pressure range is between 0.1 and 100 Torr.

31. The process of claim 26, wherein the pressure range is between 0.5 and 2.5 Torr.

32. The process of claim 26, wherein the temperature range is between 500°C and 3000°C.

33. The process of claim 26, wherein the temperature range is between 950°C and 1000 °C.

34. The process of claim 26, wherein the metallic oxide source mixture comprises ZnO, $In_2O_3$ or combinations thereof

35. The process of claim 24, wherein the metallic oxide source mixture is a combination of ZnO, $In_2O_3$ and graphite.

36. The process of claim 26, comprising two metallic oxides in a 1:1 ratio.

37. The process of claim 36, wherein the metallic oxides are ZnO and $In_2O_3$.

38. The process of claim 26, wherein the symmetric nanostructural morphology is selected from the group consisting of a nanobridge, nanonail, nanoribbon, nanowire, nanowall, nanobrush and combinations thereof.

39. The process of claim 26, wherein the metal oxide material comprises at least one crystalline metallic oxide, said metallic oxide being arranged in a three-dimensionally

periodic orientation so as to confer a nanostructural morphology with pre-determined symmetry to said crystalline metal oxide material.

40 The process of claim 39, wherein metallic oxide material comprises a first metallic oxide and a second metallic oxide, wherein said first metallic oxide forms a central nanostructural spine having a linear axis, whereupon said second metallic oxide forms terminally attached three-dimensional periodically oriented linear nanostructural rods, the linear axes of said nanostructural rods being oriented substantially non-parallel to the linear axis of said nanostructural spine of said first metallic oxide.

41. The process of claim 26, with a pre-determined symmetry consisting essentially of 2-fold symmetry, 4-fold symmetry or 6-fold symmetry or combinations thereof.

42. The process of claim 40, wherein the central nanostructural spine consists essentially of $In_2O_3$.

43. The process of claim 40, wherein second metallic oxide consists essentially of ZnO.

44. The process of claim 40, wherein the nanostructural rods comprising the second metallic oxide are substantially orthogonal to the linear axis of the central nanostructural spine.

45. The process of claim 40, wherein the nanostructural rods comprising the second metallic oxide are slanted to the central nanostructural spine, so as to form a finite, non-orthogonal angle with the linear axis of said central nanostructural spine.

46. The process of claim 40, wherein at least one of the metallic oxides further comprises a dopant material..

47. The process of claim 46, wherein the dopant material is tin.

48. A process for the formation of a nanostructural device comprising the steps of:

a) adherently depositing a catalyst material in a microparticulate form in a predetermined configuration on the surface of a substrate material so as to provide a plurality of catalytic sites on the surface of said substrate material.

b) initiating growth of microparticulate crystals of a metallic oxide at the catalytic sites so as to form a plurality of three-dimensional periodic nanostructural crystalline nodes comprising said metallic oxide; and

c) allowing continued crystal growth of the metallic oxide so as to render the nanostructural crystalline nodes of said metallic oxide to become connected by three-dimensional periodically aligned nanowire structures comprising the metallic oxide.

49. The process of claim 48, wherein the metallic oxide is $In_2O_3$.

50. The process of claim 48, wherein the catalyst material comprises gold. or gold-zinc alloy.

51. The process of claim 48, wherein at least one of the metallic oxides further comprises a dopant material.

52. The process of claim 51, wherein the dopant material is tin.

53 A microelectronic device comprising a metal oxide material comprising at least one metallic oxide wherein said metallic oxide is aligned in a three-dimensionally periodic orientation so as to confer symmetric nanostructural morphology to said metal oxide material.

54. The microelectronic device of claim 53, selected from the group consisting of field emission device, photovoltaic device, optoelectronic device, blue optical device, ultra-violet optical device, transparent conductive film, transparent electronic imaging shielding device, transparent field effect transistor, supercapacitor, fuel cell, nanocomposite, data-storage device, biochemical sensor, chemical sensor, gas sensor, solar cell, photocatalysis device, bulk acoustic waves device, window heating device, and light emitting diode.